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This paper examines evidence supporting the hypothesis that environment differentially affects intelligence in a sex-specific manner. The current position that environment and heredity contribute interactively to intelligence obscures the greater vulnerability and exposure of males to environmental influences and the reciprocal lack of equivalent environmental stimulation which leads by default to a larger genetic component of intelligence for females. Several hypotheses related to the sex-differentiated interaction of environmental and hereditary determinants of intelligence are discussed. (Author/MS)

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The Sex Differentiated Interaction
of Environmental and Hereditary Determinants
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Paper examines evidence supporting the hypothesis that environment differentially affects intelligence in a sex-specific manner. The current position that environment and heredity contribute interactively to intelligence obscures the greater vulnerability and exposure of males to environmental influences and the reciprocal lack of equivalent environmental stimulation which leads by default to a larger genetic component of intelligence for females.

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The Sex Differentiated Interaction
of Environmental and Hereditary
Determinants of Intelligence

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For several years developmental psychologists probed the determinants of intelligence and intellectual growth, seeking to discover the key to optimal intellectual development. Philosophical and research interests focused, in the extreme, on the question of whether intelligence was determined by an inviable genetic inheritance or was an artifact of environmental determinants. Along with others, Anastasi (1958) congenitly summed the emerging viewpoint from this controversy that neither heredity nor environment was solely responsible for an individual's intelligence. Rather, the interaction and reaction of an individual (with his unique genetic makeup) to the particular environment in which the individual existed would determine the intelligence of that individual. Refinements such as Dobzhansky's (1950) idea of genetic limits within which environment can minimize or maximize genetic potential and Jones' (1954) position of environmental limits posed by inadequate social milieus were still seen as possible explanations. However, the basic premise offered by Anastasi of interaction as the critical process was not negated.

In line with this viewpoint of interacting determiners of intelligence, the thrust of more recent developmental investigations has been in the direction of describing and analyzing the mechanisms or factors involved in the

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interactive contributions of heredity and environment to intellectual development. Of these factors, parental characteristics and socialization practices have received much attention. (Bayley and Schaefer, 1964; Beckwith, 1971; Bing, 1963; Gray and Miller, 1967; Honzik, 1967; Moss and Kagan, 1958). Coupled with the "rediscovery" by psychologists that the very early years of childhood are a blueprint for later learning and lifestyles (Evans, 1971), research interests have narrowed to those parent-related factors, especially maternal, which specifically affect the very young child or infant. The child-rearing patterns of our culture place most of the burden for the care of the infant on the mother or another substitute. Maternal behaviors, then, constitute a primary component of the infant's environment (Yarrow, 1963).

Bayley and Schaefer (1964) using data from the Berkeley Growth Study undertook a longitudinally-based examination of maternal and child behaviors in relation to mental development of the child. Based upon their data analysis showing boys' intelligence to be more highly correlated with maternal behaviors than with maternal intelligence estimates; while girls' intelligence correlated consistently higher with the maternal intelligence estimates, Bayley and Schaefer posit an interesting hypothesis concerning the determinants of intelligence, namely, that the basic determinants of intelligence are sex-differentiated. Maccoby (1966) summarized the hypothesis, "... the intellectual performance of boys is more responsive to environmental events, while that of girls has a larger component of genetic control [p. 38]." Maccoby (1966) further commented that, "Existing data, then do not permit us either to support the hypothesis or to reject it unequivocally, and the issue must remain open for further evidence [p. 38]." Gray and Miller (1967) also noted the Bayley and Schaefer hypothesis, but failed to comment on its viability.

A closer look at the hypothesis of sex differentiated determinants of intelligence immediately raises the spector of the old heredity versus environment controversy. Is this new hypothesis merely a sophisticated translation of the old extreme questions with each polar position now given a sex label: female superimposed over inviable genetic inheritance and male superimposed over environment? Or is the introduction of speculation on sex-differentiated determinants of intelligence a breakthrough in cracking the shell surrounding the interactive contributions of heredity and environment?

Evidence points to the latter supposition. Biological differences between the sexes which are directly linked to differences in intellectual development have not been substantiated (Witkin, 1969). Some evidence for stronger genetic determinants for girls has come from the following studies. Bayley and Schaefer (1964), as noted previously, report higher correlations for girls with estimated maternal intelligence. Their reanalysis of the data from the Skodak-Skeels study on adopted children uncovered similar findings regarding girls' intelligence and maternal intelligence, with the correlations being higher for girls and their natural parents over girls and their foster parents. Because these children lacked any environmental contacts with their natural parents, the findings concerning the relationship of intelligence between girls and their natural parents can be assumed to be free from confounding environmental influences. Moss and Kagan (1958) and Honzik (1957, 1963) also found that maternal IQ's predicted girls' IQ's at a much earlier age than boys' IQ's.

Admittedly this is scant and indirect evidence to build a case for a stronger genetic determinant of intelligence operating for girls than for boys. Part of the problem in assessing the relative contributions of genetic components to intelligence on a sex differentiated basis is that in the past researchers merely looked to see if maternal intelligence was correlated with child's intelligence; or if twins' intelligence correlated with natural or adopted parents, or more for identical or fraternal twins (Bayley, 1970). Data was not routinely analyzed with sex as an important and discriminating variable.

Thus, until further and more definitive research comes forth from the biological sciences and a body of psychological literature containing data analysis in which sex is a variable becomes a reality, Bayley and Schaefer's hypothesis must be examined through the lens of environmental or socialization forces as they may impinge differentially on males and females in regard to their intellectual development. The complex constellation of societal mores leading to sex-typing are presumed to be external environmental forces which immediately and inescapably operate on the new organism. Genetic sex differentiated determinants of intelligence, if there are any, are inexplicably confounded with environmental components of sex-role socialization.

The inverse of Bayley and Schaefer's hypothesis is not just to postulate that boys' intellectual development is more responsive than girls' intellectual development to environmental influences. The issue can be subdivided further into three hypotheses to posit (1) that equivalent environmental influences will have greater effects on boys' intelligence than on girls' intelligence, (2) that girls' intelligence may not be responsive to the same set of environmental influences that affect boys' intelligence, and/or (3) that sex overrides any environmental equality, so that each sex develops in qualitatively different environments melded from similar appearing components.

Once again definitive conclusions cannot be reached from the available literature. Much research has been done investigating maternal behaviors in relation to intellectual development, but only a small proportion of the research effort has either looked specifically at sex differentiated impacts or been cognizant of sex differences as an explanation for inconclusive findings.

In spite of this fact of inconclusive evidence, a closer examination of each of the positions stated above does present the possibility of interesting subtleties and gradations concerning the question of sex differences and basic intellectual determinants. The remainder of this essay will be devoted to a closer examination of each of the three hypothetical positions stated above and conclude with a summary comment on the viability of the overall hypothesis concerning sex differentiated determinants of intelligence.

First, let us look at the hypothesis that equivalent environmental conditions or stimuli will have a greater effect on boys' intelligence than on girls' intelligence. Immediately, the distinction between greater effects and different effects on each sex must be noted. This distinction is an outgrowth of the original hypothesis that environmental influences would be greater for boys; thus, a secondary hypothesis must also posit increased effects by sex, not just different effects.

The assessment and validation of just what constitutes equivalent environmental effects presents a formidable design problem, and simultaneously raises the question of equivalent perceptions for each sex. The placing of all subjects in the same laboratory setting would alleviate much of the design concern for environmental equivalency; assuming adequate controls over the laboratory setting. Yet, work by Mischel (1970) and many others of a social learning theory bent raises the question of whether personal or individual perceptions may not in fact alter seemingly similar-appearing physical environments in a significant way. Hamburg and Lunde (1966) in citing numerous studies supporting the presence of sex-specific hormones which may alter behavior responses to the same stimuli, adds some hint again of genetically linked sex-differences to the question of whether environments ever appear similar or are perceived as equivalent by different-sexed children.

From a methodological viewpoint this hypothesis presents formidable design problems and concerns of content validity as soon as subjects are placed or observed in anything but a rigidly controlled laboratory environment. Also, social learning theorists have raised an important issue concerning the rating of environmental equivalency because of differences in person-perception which will only be aggravated by each individual's sex-typing and sex role learning. Relevant here also is the idea of environmental factors being differentially reinforcing by sex.

Outside the laboratory, the closest we can perhaps come to a universally accepted equivalent physical environment for all children in a natural setting is the Israeli kibbutz. Not only are all children communally raised and cared for in this setting, but the kibbutzim emphasis on equality of the sexes is

a qualitative component which would lend credence to the assessment of the situation as environmentally equivalent for both sexes. Gewirtz and Gewirtz (1968) operating on this assumption scrutinized the caretaking practices in the kibbutzim. They reported a measurable difference in the amount of caretaking boys received over the amount of caretaking that girls received. This obviously exploded the notion of equivalent environments for each sex in this kibbutz. Gewirtz and Gewirtz speculated that a contributing factor to the increased care given to boys may have been a "constitutional" factor specific to boys which required or drew more caretaking responses from the environment. While there may have been many reasons for their speculation of a constitutional factor as an explanatory discrepancy variable, it is interesting to note that the explanatory factor Gewirtz and Gewirtz mention indirectly raises the possibility of genetically related or determined sex differences operating within the environmental limits of the kibbutz.

In summary, without even mentioning the issue of intelligence, the hypothesis that equivalent environments will have greater effects on boys' intelligence than on girls' intelligence is not currently testable because of methodological and measurement problems. Nevertheless, discussion of this hypothetical position does lend some shady support for the notion of a sex differentiated interaction of genetic and environmental determinants of intelligence. The supposition of greater effects for boys is irrelevant considering the methodological problems, but is salient to the next hypothetical position which will be discussed.

The second hypothetical position which we are going to look at in greater detail is the position that girls' intelligence may not be responsive to the same set of environmental influences that affect boys' intelligence. Along with the straightforward statement of this position is the corollary assumption just referred to in the preceding section that boys' intelligence may be more responsive than girls' intelligence to environmental influences whatever the influences may be. Thus, the second hypothesis argues for sex differentiated sets of environmental determinants of intelligence and secondarily for greater or more impact of the environment for boys than for girls.

Maternal behaviors do comprise the primary component in most young children's environments (Yarrow, 1963). Bing (1963) reports results which support the correlation of maternal behaviors with boys' preschool IQ but not girls' preschool IQ. This later could be construed as a lack of environmental contact for girls. Moss and Kagan (1958) conclude that different sets of variables predict boys and girls IQ.

Honzik's (1967) findings support the hypothesis of different environmental stimuli being important for each sex. Rather than any maternal influences, she found father's friendliness to be most related to girls' IQ. Maccoby (1966) cites evidence to support that cross-sex typing predicts higher measures on analytic thinking for girls and for boys, giving additional evidence of differential salient environmental stimuli; the opposite sex parent being influential both for boys and for girls.

The first two studies mentioned suggest that when looking at the environment created by the primary caretaker, usually the mother, different variables predict intelligence for each sex. The second set of studies seem to suggest that the primary maternal caretaker may not be the most important environmental stimuli for girls. It is a distinct possibility that factors other than those associated with the primary caretaker, such as paternal characteristics, may be important for girls' intellectual development.

The question of greater environmental impact of environmental factors on boys' intellectual development is not rendered methodologically improbable by this second hypothesis. In fact, since the primary caretaker for most young children is the mother or maternal caretaker, it may be quite reasonable to postulate greater environmental influences for boys; since boys' intelligence appears to be more consistently correlated with various maternal behaviors. Boys may be more influenced by environment in their intellectual development just because they are constantly in contact through their daily routines with one of the primary determiners of their intelligence - the maternal caretaker.

In summary, hypothesis two that girls' intelligence may not be responsive to the same set of environmental influences as boys' intelligence remains plausible in light of present research findings. There is even reasonable support for postulating a greater or more influential impact of the maternal child-rearing environment on boys' intelligence than on girls' intelligence.

However, it should be noted that the overall hypothesis from which this second hypothesis was derived postulated not only a greater environmental determinant of intelligence for boys, but a greater genetic determinant of intelligence for girls. While this discussion does favor a greater environmental determinant of intelligence for boys, no support is given or rationale offered for assuming that girls' intelligence is determined by anything other than different environmental stimuli. We would have to assume that genetic factors were of greater importance for girls simply because the environment, by default more than by design, contained factors which were not the primary determinants of the girls' intelligence.

Perhaps, the biggest genetic determinant of intelligence is simply the sex of the child. That is male and female are the smallest analyzable genetic unit determining intelligence. Hypothesis number three which says that sex overrides any environmental equality, so that each sex develops in qualitatively different environments melded from similar appearing components assumes this genetic sex dichotomy.

Feshbach (1970) in studying aggression reported that biological male-female differences in physical strength and motoric impulses lead to different sets of behaviors and subsequent reinforcers: Creating environments which are different because of sex determined genetic differences. Lewis (1972), in looking at behaviors rather than biologically induced environmental differences, found that differences could be observed in the mother-child interactions according to sex of infant. Supporting the hypothesis that sex of child alone creates different environments.

Crandall, Katkowsky and Preston (1962) looked at what could be considered self perceptions of environments. They found that in selecting statements describing their intellectual abilities, boys selected statements which were highly correlated with their intelligence and girls selected statements which were negatively correlated with their intelligence. They suggested that these results may be tapping self perception of sex differentiated environmental reinforcers.

The evidence from these studies along with social learning theory arguments regarding sex-role learning does lead to the tentative conclusion that environmental forces operate so strongly that the sex-label attached to a particular child may be enough to forever differentiate the impact of the environment on his or her intellectual development.

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